MESOZOIC NON-MARINE MOLLUSCA (PELECYPODA: UNIONIDAE) FROM THE NORTH OF SOUTH AUSTRALIA

by N. H. Ludbrook*

[Read 13 October 1960]

SUMMARY

Three species of Triassic freshwater mollusca of the family Unionidae occur in the Leigh Creek and Springfield Coal Basins. One species, *Unio eyrensis*, is redescribed and two, *Unio springfieldensis* and *Protovirgus jaenschi*, described as new. One Lower Cretaceous (Neocomian) species, *Protovirgus coatsi*, is described from the upper part of the Blythesdale Group on the Gardiner Military Sheet.

INTRODUCTION

This report deals with Triassic and Lower Cretaceous freshwater mussels collected by officers of the Geological Survey of South Australia during mapping of the Gardiner Military Sheet, bordering the north-eastern Flinders Ranges, about 350 miles north of Adelaide, and during investigation of the economic prospects of the Springfield Coal Basin about 210 miles north of Adelaide in the Flinders Ranges. The fauna of the Leigh Creek Coalfield is also considered.

Holotype and hypotype material is lodged in the Adelaide University Geology Department.

Abbreviations used for collections are:

A.U.G.D.: Adelaide University Geology Department.
A.M.: Australian Museum, Sydney.
N.M.V.: National Museum, Victoria.
S.A.M.: South Australian Museum.
G.S.S.A.: Geological Survey of South Australia.

THE SPRINGFIELD TRIASSIC FAUNA

During 1958 the South Australian Department of Mines investigated the economic prospects of the Springfield Basin, a structural basin containing Triassic sediments similar in many respects to those of the Leigh Creek Coal Basin. Results of mapping and drilling the Basin (Johnson, in press) and petrological studies of the pseudo-igneous rocks (Johnson and Bucknell, 1959) have been published elsewhere.

The Springfield Basin, located in moderately hilly pastoral country 26 miles north-east of Quorn, 239 miles by road north of Adelaide, is accessible from the road running east from the deserted town of Gordon to Cradock. Fossil freshwater mollusca were collected by W. Johnson and C. von der Borch from the pink and buff argillites at the top of the succession on the remnant mesa in the centre of the basin (Johnson and Bucknell, 1959, p. 247). Further material was collected by Dr. Mary Wade and the writer on April 24, 1960.

Two species are present in the pink and buff argillites, both previously undescribed. The brittle conchoidal fracture of the argillites does not assist

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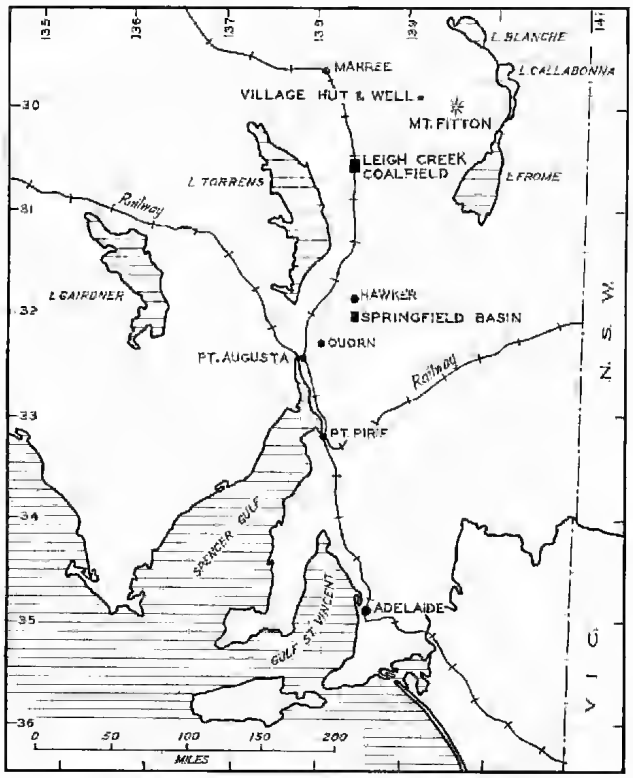
recovery of the specimens; preservation is poor and almost entirely as moulds, with valves open. An occasional specimen occurs with black epidermis retained on the mould. Associated with the mussels are numerous plant remains, principally *"Thinnfeldia" feistmanteli,* recently redescribed (Townrow, 1957) as *Dicroidium feistmanteli.*

THE LEIGH CREEK TRIASSIC FAUNA

The geological setting in which the Triassic molluscs occur on the Leigh Creek Coalfield operated by the Electricity Trust of South Australia has an extensive literature reviewed in Bulletin 31 of the Geological Survey of South



Locality Map.

Australia (Parkin, 1953). *Unio eyrensis* described from the field in 1891 was known only from limonitic casts until 1957 when Mr. A. E. Jaensch of Leigh Creek showed the writer the specimen (pl. 1, fig. 1) from which the external features of the shell can now be described. *Unio eyrensis* has not so far been found in the Springfield Basin, but a specimen of the *Protovirgus* here described as *Protovirgus jaenschi* which is a distinctive species of the Springfield fauna was found among original material from Leigh Creek in the Tate Collection at the University of Adelaide. The Leigh Creek specimens are much more substantial than those from Springfield.

THE LOWER CRETACEOUS SPECIES

The two specimens which represent the entire knowledge of the new species *Protovirgus coatsi* were collected on the Gardiner Military Sheet on the margin of the Great Artesian Basin off the north-eastern slopes of the Flinders Ranges, locality P/L 915 Sheet 115, 1 mile south-south-east of Western Spur, 3 miles south of Village Well. The species occurs as ironstone casts weathered out of ferruginized gritty sandstone with plant impressions belonging to the upper part of the Blythesdale Group. The age is considered to be Neocomian.

SYSTEMATIC POSITION OF THE MATERIAL

In restoring *Unio eyrensis* to the genus *Unio* and confirming Etheridge's recognition of the presence of the Unionidae in the Australian Triassic, the writer differs from McMichael and Hiscock (1958) who have (pp. 493, 495) on the assumption that *Unio eyrensis* was sculptureless and might be presumed to be a primitive mutelid, postulated the arrival of the Australian mutelid stock during the Triassic.

Certain morphological features of *Unio eyrensis* – the deep conical anterior adductor impression bounded by a buttress and the internal subumbonal ventral ridge are related to those of some early Mesozoic genera of the Cypricardiacea, notably *Kalentera* Marwick, 1952, and less closely to *Palaeopharus* Kittl, 1907. The similarity between the hinge-characters of *Palaeopharus* and of *Unio* were observed by Kobayashi and Ichikawa (1951, p. 8), who suggested that *Palaeopharus* might be a transitional form between the Pleurophoridae and the Unionidae, and the Unionidae characterised by pseudo-cardinals might be polyphyletic (p. 9). Cox (1960, p. 81) has recently discussed the possible origins and phylogenetic relationships of the Unionacea.

SYSTEMATIC DESCRIPTIONS

Family UNIONIDAE

Subfamily UNIONINAE

Genus UNIO Philipsson, 1788

Type species (I.C.Z.N.) *Mya pictorum* Linné

Unio eyrensis Etheridge jr.

(pl. 1, figs. 1-6; pl. 2, fig. 5)

Unio eyrensis Etheridge jr., 1891, p. 11, pl. 3, figs. 1-3; 1892, p. 389, pl. 28, fig. 1.
Prohyria eyrensis (Etheridge jr.) McMichael, 1957, p. 228, pl. 13, figs. 8, 11 (*non* figs. 9, 10).

Diagnosis—A large solid fairly broad *Unio*, heavily sculptured with flattened concentric ridges, hinge with two triangular pseudocardinals and one long posterior lateral in the right valve, one triangular pseudo-cardinal and two long posterior laterals in the left valve. Anterior adductor impression deep, bounded by a buttress. Broad low subumbonal-ventral ridge on the interior.

Redescription – External characters (known from hypotype A.U.C.D. F 15472)—Shell inequilateral, elongate-ovate, rounded anteriorly, bluntly pointed posteriorly, inflated and solid. Periostracum thick, dark brown. Sculpture of prominent narrow flattened concentric ridges a maximum of 5 mm. apart in the dorsal half, fine concentric lirae between the ridges; owing to preservation ventral half showing fine growth lines and rest marks only. Beaks somewhat flattened, curved inward and forward, situated anteriorly. Smooth for about 10 mm. then

wrinkled with irregular bifurcating plications for about 8 mm. before the first concentric ridge develops.

Anterior margin short, curved downwards under beaks, then roundly curving to ventral margin, posterior-dorsal margin nearly straight; ventral margin gently arcuate.

Ligament large, prominent, long; lunule apparently long, narrow and inconspicuous.

Internal Characters (holotype A.U.G.D. T 1347)—Shell deep, inflated, hinge plate fairly wide and flat with two triangular pseudocardinals and one long posterior lateral in the right valve, one triangular pseudo-cardinal and two long posterior laterals in the left valve.

Anterior adductor impressions deep and conical, bounded posteriorly by a strong buttress, anterior retractor impressions small, posterior adductor impressions inconspicuous. Pallial line firm. A broad low subumbonal-ventral ridge in front of which the shell was probably thicker than it was posteriorly. Ridge represented by a conspicuous sulcus on casts by which the species is mostly represented. The sturdiness of the shell is indicated by the fact that the casts are fully inflated showing no signs of collapse during deposition.

Dimensions—Holotype (internal cast) T 1347: Length 87 mm., height 45 mm., inflation (both valves) 40 mm., ratio posterior:anterior 75:12 mm.

Hypotype. F 15472: Length (est.) 90 mm., height 54 mm., inflation (both valves) 41 mm. posterior; anterior approx. 72:18 mm.

Location of Types—Holotype Tate Coll., A.U.G.D. T 1347; Hypotype A.U.G.D. F 15472; Paratype Aust. Museum, Sydney, A.M. F 9081.

Type Locality—Black Hills, Leigh Creek, latitude 30°30′, longitude 138°25′, on the southern end of the Leigh Creek Coalfield (Parkin, 1953; Parkin and King, 1953b, Sheet Myrtle). 1½ miles south of the present township of Leigh Creek and 3 miles north of the Copley Railway Station, formerly Leigh Creek R.S. and shown as such on H. Y. L. Brown's map 1891. *Unio eyrensis* weathers out as casts from ferruginous sandy shales occurring just above the Main or Telford Seam, which is about 400 feet above the base of the Triassic sequence (verbal information of R. K. Johns).

Material—The holotype T 1347. A note on the original label in Etheridge's handwriting reads "1 taken as duplicate"—this would be the paratype A.M. F 9081, which carries a similar label.

The hypotype A.U.G.D. F 15472 collected by A. E. Jaensch about 1945 in Telford Cut shortly after commencement of operations about 10 ft. from the surface on top of shale on the up-dip of the Cut and now presented to the writer for lodging in the Adelaide University Geology Department, and the following topotypes:

(1) *Adelaide University Geology Department.* 19 specimens in all, including one from Tate's original material labelled "Burnt Plain 10-12 miles north of Leigh Creek". 12 internal casts, about half of which show the hinge features; 3 showing traces of external sculpture, 1 external mould.

(2) *South Australian Museum.* 31 topotypes, including P 2414 2 ferruginous casts labelled "*Unio eyrensis* Tate" from old collection of S.A. School of Mines; P 2589 labelled "*Unio eyrensis* Tate" collected from shale and probably original Tate material, some shell preserved near the umbo, casts of anterior adductor impressions very well shown; P 4435 cast in shale from S.A. School of Mines old collection; P 9096 seven ferruginous casts collected by Sir Thomas Playford 1945; P 13028 twenty limonitized casts collected Dr. B. Daily 7/11/59 from ridge outcropping 1 mile SSW of present town of Leigh Creek.

(3) *Geological Survey of South Australia.* 16 topotypes with the following dimensions:

Length	Height	Inflation	Posterior:anterior
85≠	45	36	73:12
110	55	40	85:25
100	50	41	obscured
75	38	38	60:15
63+	40	32	obscured
78	42	42	obscured
81	43	35	71:10
72+	43	28	57+:15
110≠	52	37	85:25
85≠	46	39	73:12
64	37	24	54:10
92≠	45	35	79:13

≠ estimated.

Geological Survey of Queensland.

Hypotype F 2450 Bundamba S.E. Qld. "in brick clay overlying coal". Ipswich Coal Measures (Upper Triassic) mentioned Etheridge jr. 1892 G.S.Q. Pub. 92, p. 389. Coll. J. Malbon Thompson.

Hypotype F 227 Bundamba S.E. Qld. "in brick clay overlying coal". Ipswich Coal Measures (Upper Triassic) figd. Etheridge jr. 1892 G.S.Q. Pub. 92, pl. 28, fig. 1. Coll. J. Malbon Thompson.

Observations—McMichael (1957, p. 227) introduced the genus *Prohyria* for *Unio johnstoni* Etheridge jr., of which he had 5 specimens, and *Unio eyrensis* Etheridge jr. of which he examined and figured the paratype (A.M. F 9081 pl. 13, fig. 8) and probable topotype (N.M.V. P 16767 pl. 13, figs. 11, 12). The specimen N.M.V. P 16761 (pl. 13, figs. 9 and 10) referred to *U. eyrensis* from Lake Eyre was kindly lent to the writer by the National Museum of Victoria. It is neither morphologically nor lithologically related to the Triassic species and is a well-preserved example of the Aptian marine species *Panopea maccoyi* which, by comparison with other specimens including *Panopea maccoyi* collected by Dr. B. C. Forbes from the Lower Cretaceous of Fred's Springs two miles east of Lake Eyre railway siding, has almost certainly come from the same locality. The locality "Lake Eyre" (attached also to the holotype of *Unio eyrensis*) is a hazard for students of museum specimens, as a fairly wide geographical and stratigraphical range was included in the name "Lake Eyre Basin" in early records.

Unio johnstoni by original designation is the type species of *Prohyria*, but the generic description given by McMichael includes that of the "hinge well developed, with large cardinal teeth" of *Unio eyrensis*. The hinge of *Unio johnstoni* has not been described.

The two species appear to be unrelated. The hinge of *Unio eyrensis* is unionid (pl. 1, fig. 5) and can be reproduced in latex from many of the limonitic casts in which the species is usually preserved. The casts show very characteristic internal shell features—a broad well-marked umbo-ventral depression which corresponds to the internal ridge on the shell interior and the deep conical anterior adductor muscles bounded posteriorly by a buttress are represented negatively (pl. 2, fig. 5). These are clearly visible in the paratype F 9081 (McMichael, pl. 13, fig. 8) and were well illustrated in the original figures of

the holotype (Etheridge, 1891, pl. 3, figs. 1-3) here refigured (pl. 1, figs. 2, 3, 4). The internal characters have features in common with the living European *Unio tumidus*, although the pseudo-cardinals are narrowly cuneiform like those of the Bear River Cretaceous *Ligumia vetustus* (Meek) and the Laramie Cretaceous *Margaritifera endlichi* (White), recently allocated (Modell, 1957) to genera other than *Unio*. Etheridge (l.c. p. 12) drew similar comparisons in his original description: "Little more can be said of these Mesozoic Unios, except that they are quite unlike any of the Recent Australian species, being evidently much more substantial shells. In the presence of the partition behind the anterior muscular scars our fossils correspond to a certain extent with some of the more ponderous American species." The species was known only from internal moulds until Mr. A. E. Jaensch collected the splendid specimen (pl. 1, fig. 1) from Telford Cut on the Leigh Creek Coalfield which has enabled the external characters to be determined for the first time. European Tertiary Unios (Modell, 1959) appear to have somewhat similar sculpture.

The species from Bundamba, Queensland, Ipswich Coal Measures (Upper Triassic), referred to *Unio eyrensis* "Tate" (Etheridge, 1892, p. 389, pl. 28, fig. 1) is retained in the synonymy. The two specimens C.S.Q. F 227 (figd. Etheridge l.c. pl. 28, fig. 1) and F 2450 (internal cast mentioned by Etheridge, p. 389) have been kindly lent by the Geological Survey of Queensland. Both are close to and congeneric with *Unio eyrensis*, although the strong concentric ribbing is not preserved. The Queensland specimens are very thick shelled and solid, with relative dimensions: F 2450 length 71, height 34 mm.; F 227 length (estimated) 79, height 38 mm.

Like the Leigh Creek examples, they are preserved as limonitized casts for the most part, with internal features similar to those of the type series. Their habitat was probably similar also. In shape and such features as are preserved the Bundamba specimens may be compared with the living European *U. tumidus* Philipsson and with *Unio karrooensis* Cox from the Manda Beds (Lower Stormberg, or Upper Triassic) of the Ruhuhu Coalfields, Tanganyika (Cox, 1932).

Apart from the conspicuous concentric sculpture, the writer is unable to distinguish any generic characters which would appear to separate the Triassic *eyrensis* from *Unio*. The species has so few morphological characters in common with *Prohyria johnstoni* that its retention in *Prohyria* seems unwarranted. The genus *Unio* is therefore regarded as the best available location for *eyrensis* at present.[1] *Unio* was formerly considered to be established in North America as elsewhere during the Triassic (White, 1907; Henderson, 1935), but most of the American species have now been placed in other genera (Modell, 1957).

The strong sculpture and substantial nature of the shell of *eyrensis* and the restricted area in which most of the specimens are found indicates that they were probably of fluviatile habitat, deposited at the mouth of a river entering the Leigh Creek Basin.

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[1]While the present paper was in proof volume 87, part 2, of the Records of the Geological Survey of India dated 1958 was received. This contained a paper by M. R. Sahni and A. P. Tewari entitled New Unionids from the Triassic (Gondwana) Rocks of Tihki, Vindhya Pradesh and Maleri, Hyderabad, Deccan. *Rec. Geol. Surv. India* vol. 87, pt. 2, pp. 406-417, pls. 1-2, in which the authors have described four species of unionids from the Upper Triassic of India for which the genus *Tihkia* is created. From the figures and description, *Tihkia corrugata* agrees so closely with *Unio eyrensis* that there can be little doubt that they are congeneric. If, therefore, *Unio* is not the correct location for *eyrensis* and *springfieldensis* the genus *Tihkia* should be considered for these species.

Unio springfieldensis sp. nov.

(pl. 2, figs. 1-2)

Diagnosis—A medium sized thin *Unio*, smooth but for growth lines, posterior margin broadly rostrate.

Description—Shell of moderate size, apparently thin and easily squashed, broadly wedge-shaped. Anterior margin somewhat obliquely arcuate; posterior margin produced and broadly rostrate where preserved. Cardinal margin arcuate. Anterior dorsal margin oblique and gently slightly arcuate posterior dorsal margin nearly straight. Ventral margin curved; a slight umbo-posterior ridge. Ligament prominent. Shell apparently nearly smooth but for fine growth lines and irregular concentric folds which are probably mostly due to compression of the shell during deposition. Internal features unknown.

Dimensions—Holotype external mould A.U.G.D. F 15473. Length 75 + (estimated 85) mm.; beak height 30 mm.; posterior:anterior ratio 60:25 mm. Ligament 19 mm. Paratype: A.U.C.D. F 15474. Length 90, beak height 36 mm.

Material—Holotype and paratype both external moulds and examined from latex casts, both valves open and preserved upside down on weathered surface of argillite. Paratype G.S.S.A. F 44/60 figured pl. 2, fig. 2 showing posterior margin. Paratype: External mould of a fairly large specimen preserved upside with 2 valves open flat and partly obscured: valves crumpled. Length 100 mm., beak height 30. Topotypes 2 moulds of single valves and 23 incomplete impressions.

Location of Types—Holotype A.U.G.D. F 15473. Paratype A.U.G.D. F 15474. Paratype Geol. Surv. S.A. F 44/60.

Type Locality—Small central mesa, Springfield Basin, Section 48, Hundred of Cudla Mudla, 13 miles west of Cradock, in pink and buff argillites at the top of the Triassic succession.

Observations—In contrast with *Unio eyrensis*, this thin, smooth species was probably of lacustrine habitat and was deposited in the fine mud of the still waters of the Springfield Basin.

Genus Protovirgus McMichael, 1957

Type species (o.d.) *Unio dunstani* Etheridge jr., 1838

Protovirgus jaenschi sp. nov.

(pl. 2, figs. 3, 4)

Diagnosis—A fairly large inflated and solid *Protovirgus* having close-set fairly coarse rounded ridges with fine growth lines towards the ventral margin.

Description—Shell narrow, elongate-ovate, beaks very anterior, situated at less than the anterior one-tenth, flattened and apparently smooth. Anterior margin short and well curved, posterior margin attenuated, obliquely rounded, dorsal margin nearly straight, ventral margin gently curved, with an inflexion in the posterior one-third. Sculpture of fairly coarse and close rounded ridges with fine growth lines, strong ventral margins. Ligament fairly long and prominent.

Hinge unknown. Shell anterior apparently with a broad subumbonal-ventral ridge represented by a sulcus on the internal cast. Anterior adductor impressions fairly deep, bounded behind by a buttress.

Dimensions—Length 80 mm.; maximum height 31 mm. (posterior to beaks); beak height 30 mm.

Type Locality—According to Tate's old label "Burnt Plain 10 to 12 miles north of Leigh Creek". This is the present location of Lobe C, northern basin,

5 miles north of Leigh Creek township, where shale outcrops continuously around the margin of the Basin (Johns, 1956, p. 138).

Location of Holotype—Tate Coll. A.U.C.D. F 15475.

Location of Paratype—F 15476.

Location of Ideotypes—G.S.S.A. F 80/58 B-C, F 43/60.

Material—The holotype F 15475, the only specimen known from the Triassic of the Leigh Creek Basin.

Paratype, external mould, from the pink argillites at the top of the Triassic succession in the central mesa, Springfield Basin.

Sample F 80/85. Ideotypes, all external moulds from pink argillites top of mesa Springfield Basin.

Observations—The hinge of the species is unknown, but some of the internal characters are preserved on the holotype. The anterior adductor and buttress though less prominent, resemble those of *Unio eyrensis*. In erecting the genus, McMichael (1957, p. 231) noted its uncertain affinities. The visible characters of the South Australian species appear to be similar to those of *Unio* and on present evidence there is no apparent reason for placing *P. jaenschi* elsewhere than in the *Unionidae*.

The species is named for Mr. A. E. Jaensch who collected the first specimen of *Unio eyrensis* showing the external features.

The external resemblance of *Protovirgus jaenschi* to the marine form *Kalentera marwicki* Grant-Mackie is, however, very striking. *Kalentera marwicki* occurs with an abundant associated marine fauna (Grant-Mackie, 1960, p. 77) in the Otapirian (Rhaetic) and Warepan (Norian) of New Zealand.

Protovirgus coatsi sp. nov.

(pl. 2, fig. 6)

Diagnosis—A medium sized *Protovirgus* with gently curved posterior ridge, convex posterior dorsal margin and concave ventral margin.

Description—Shell of medium size, compressed, elongate, narrow, length about 2¼ times maximum height, beaks anterior, situated at about one-fifth of length of shell from anterior. Maximum height just posterior to beaks. Dorsal and ventral slopes approximately parallel; dorsal margin gently convex and elevated posterior to beaks then curving more sharply downwards to the posterior margin which is produced narrowly rounded; dorsal margin slightly excavate, anterior to beaks, then straight; ventral margin concave, with a broad sinuation in the middle of the shell. Posterior ridge fairly well marked and gently arcuate. Beaks flattened, apparently unsculptured, not prominent; ligament moderately prominent, no lunule visible.

Sculpture of concentric ridges.

Internal characters unknown.

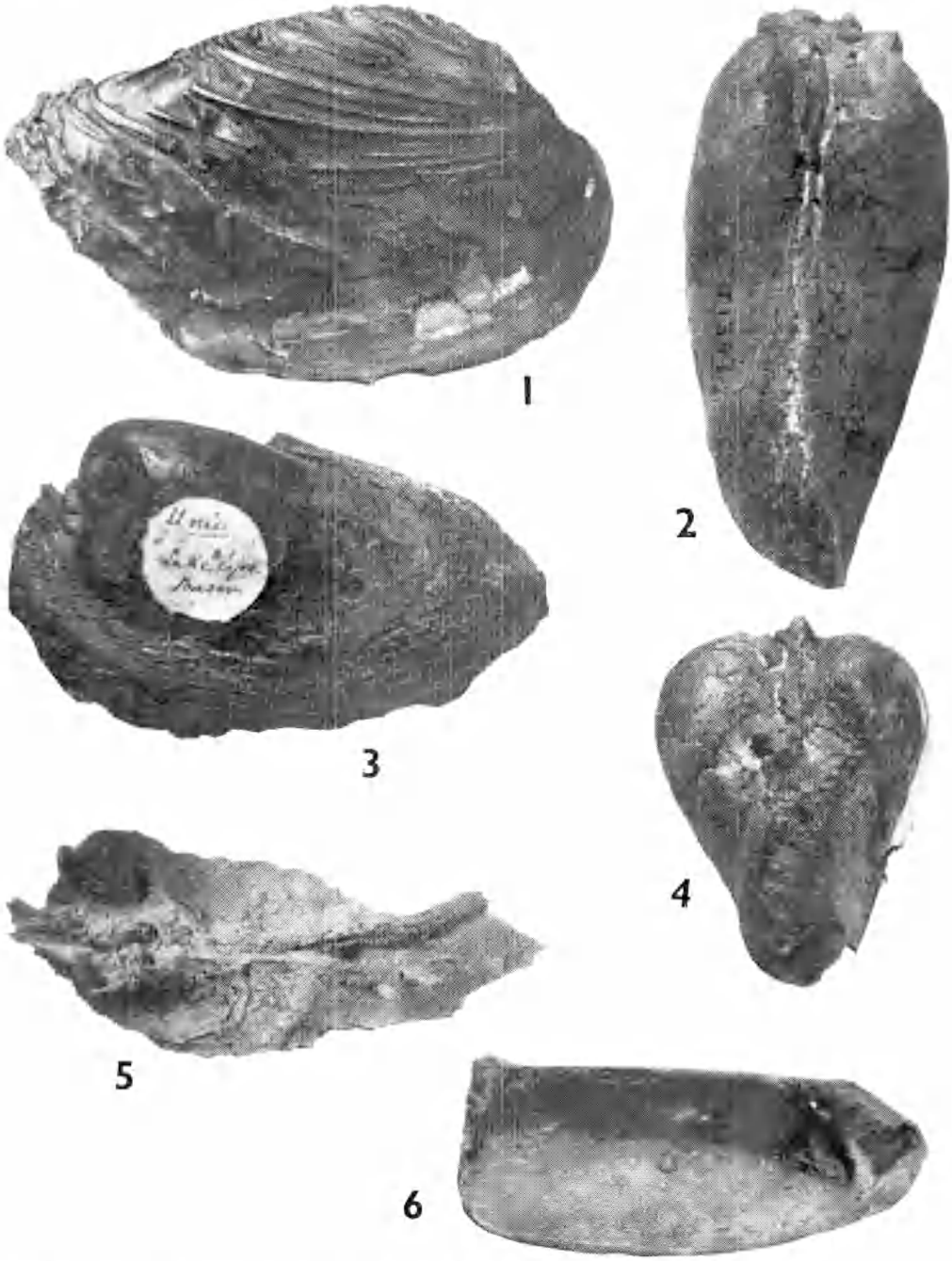
Dimensions—Length 56 mm., maximum height 25 mm., beak height 24 mm., posterior:anterior 45:11 mm.

Type Locality—Gardiner M.S., P/L 915, Sheet 115, 1 mile south-south-east of Western Spur 3 miles south of Village Well in ferruginized gritty sandstone with plant impressions.

Stratigraphic Position—Neocomian sandstones of Blythesdale Group.

Location of Holotype—A.U.C.D. F 15477.

Material—The holotype, an internal cast in ferruginized sandstone, collected R. P. Coats. One paratype, internal cast of two spread opened valves in ferruginized sandstone, collected N. H. Ludbrook, sample F 114/58.



1. *Unio eyrensis* Etheridge, jr. Hypotype A.U.G.D. F 15472.
2. *Unio eyrensis* Etheridge, jr. Holotype A.U.G.D. T 1347, dorsal view.
3. *Unio eyrensis* Etheridge, jr. Holotype A.U.G.D. T 1347, side view.
4. *Unio eyrensis* Etheridge, jr. Holotype A.U.G.D. T 1347, anterior view.
5. Latex mould of dorsal interior of holotype of *Unio eyrensis* showing hinge features.
6. Latex mould of anterior portion of left valve of holotype of *Unio eyrensis* showing anterior adductor impression and buttress.

All figures natural size, from unretouched photographs of B. Ruxton.